Acoustic and EGG examination of trilled stops in isiMpondo

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Isimpondo

- isiMpondo (≈Mpondo, ≈Pondo) is dialect from southeastern South Africa in the Nguni group
- Folk perceptions: a “deep” variety of Xhosa, and/or a lect intermediate between Xhosa and Zulu
  - Differs in numerous minor morphological ways from standard Xhosa (<Gcaleka/Rharhabe)
  - Where Mpondo differs from Xhosa, it often follows Zulu
- Scholarly literature is fragmentary

Ndrondroza

- One feature of isiMpondo is so-called ‘ndrondroza’
- In place of Xhosa [nd], [nt], Mpondo has prenasal stops with trilled release: <ndr>, <ntr>

	nt(r)	nd(r)
Xhosa	*intonga* ‘stick’	*indonga* ‘wall’
Mpondo	*intronga* ‘stick’	*indronga* ‘wall’

Ndrondroza

- NT~NTR sound correspondence seems largely systematic; not lexeme-specific, e.g.
- Points of variability (or uncertainty?):
  - indoda —> indroda ~ occasionally indrodra
    Possibly an effect related to consonant harmony?
  - We would expect Mpondo ~ Mpondro, but the former seems more widespread. However, not all Mpondo speakers produce the trills.

Questions

- What are the basic acoustic properties?
- Is there a contrast for voicing?
- If there is, where/how is the distinction realized acoustically in the sequence?
- If a distinction is realized, how does it relate to how voicing contrasts are realized in Xhosa generally?

Map of today's talk

- Background on the language and its context
- Trilled stops in other languages
- Preliminary results: acoustic and EGG data

Mpond(r)o

Deeper into Mpondo

- Mpondo is one of a handful of common labels for dialectal groups below the standard language level; most are lumped under ‘Xhosa’
- Bhaca, Hlubi, Mpondomise, Mpondo, Xesibe, Thembu, Fengu/Fingo, Mbo
- Probable etymological (and historical) affiliation between Mpondo, Mbo, Mpondomise
- Current impressions:
  - virtually all speakers are bidialectal with Std Xhosa
  - only older speakers more comfortable with Mpondo
  - not all amaMpondo speak isiMpondo

More about ndrondroza

- *ndrondroza* is an ideophone, typically used for the sound of a dying car's engine
  - trilling ~ regular cyclic oscillation
- Sociolinguistic situation: not a prestige feature
  - apparent connotations of disfluency, stuttering
  - some literature seems to predate this: Pahl 1980, Cantrell 1946, Wilkes 1979, Bachmann 1890, Nyamende 1994
  - Difficult to elicit

Questions arise

- The Ndrondroza alternation introduces trilled releases on coronal stops in prenasalized context
- Doesn't seem to have any deep phonological similarities to [r]; really not a CC cluster
- /nt/ and /nd/ both undergo this change, but the resulting surface forms are routinely distinguished: <ntr> ≠ <ndr>
- Does this result in a trill with contrastive voicing?
- What we have here looks like (a) a trill, but (b) an obstruent, and (c) supports a voicing contrast while (d) obscuring the release where that contrast is usually realized

Trills and voicing

Trills and voicing

- Crosslinguistic norm: trills are voiced, liquids
- Partial voicelessness during a trill not new
  - Finnish /r/ can have voicing interruption for one or more cycle (Ladefoged & Maddieson 1996)
  - Trills can also be devoiced, especially in clusters with voiceless obstruents
  - Neither of these is a contrast *per se*, though
- Stereotype: trilled [r] is normally a sonorant, is phonetically voiced (but not contrastively so)

Precedents

- Mangbetu (Demolin 1988, 1991, et seq)
  - 3-way contrast: voiced, voiceless, prenasal
  - for bilabials, and also retroflex coronals
- Ndebele (Ziervogel 1959?)
  - Some variety of SA Ndebele is reported to have trilled release of /nt/ and/or /nd/
- Nias (PNG) (Yoder 2010)
  - same inventory as Mangbetu, but further away

Our study

Variables

- Lect: Xhosa / Mpondo
- Voicing: T / D

Tokens

- 22 items (10 with *nd(r)* and 12 with *nt(r)*)
- Read 4 times in standard Xhosa and 4 times in Mpondo
- 173 total tokens

Sample tokens

	nt(r)	nd(r)
Xhosa	*<u>nt</u>onga* *'stick'*	*<u>nd</u>onga* *'wall'*
Mpondo	*<u>ntr</u>onga* *'stick'*	*<u>nd</u>ronga* *'wall'*

Recording setup

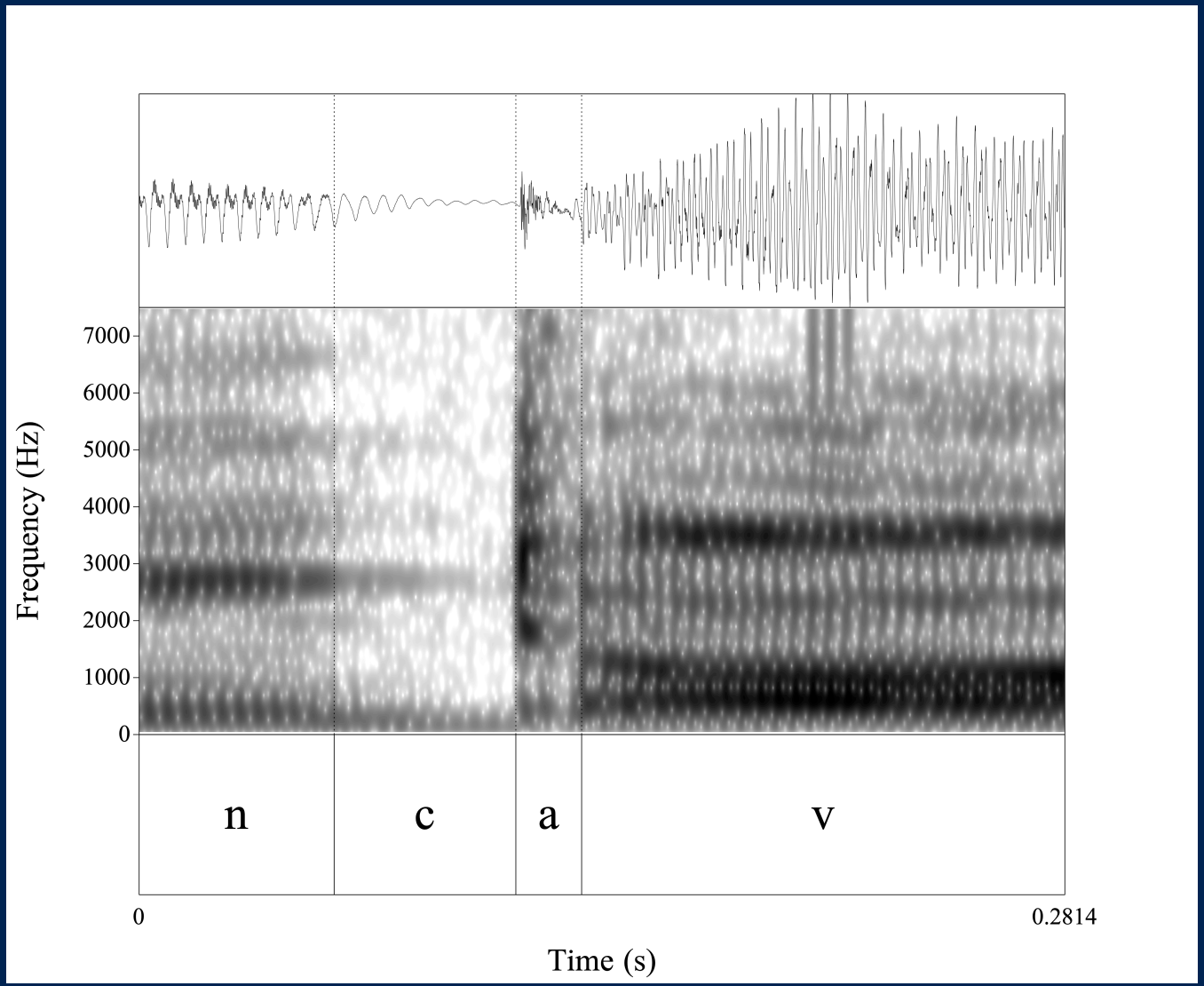
- Glottal Enterprises EG2-PCX2 electroglottograph
  - Connected to laptop via GE USB adapter
- AKG C520 head-worn condenser cardioid microphone
  - Connected to laptop via Zoom H4N recorder (as USB interface)
- Both signals recorded simultaneously in Audacity as single stereo WAV file

A
OFF
B
glottal enterprises
TWO CHANNEL ELECTROGLOTTOGRAPH
AND MICROPHONE PREAMPLIFIER
DOWN LARYNGEAL MOVEMENT UP
TOO HIGH
ELECTRODE PLACEMENT
TOO LOW
EGG SIGNAL
[BATTERY TEST]
OUTPUT LEVEL
HIGH
EGG
MIC
LOW
EG2-PCX2
PROFESSIONAL
VOICE INPUT INTERFACE
ELECTRODES
MICROPHONE
Made in the USA

Asive Nama

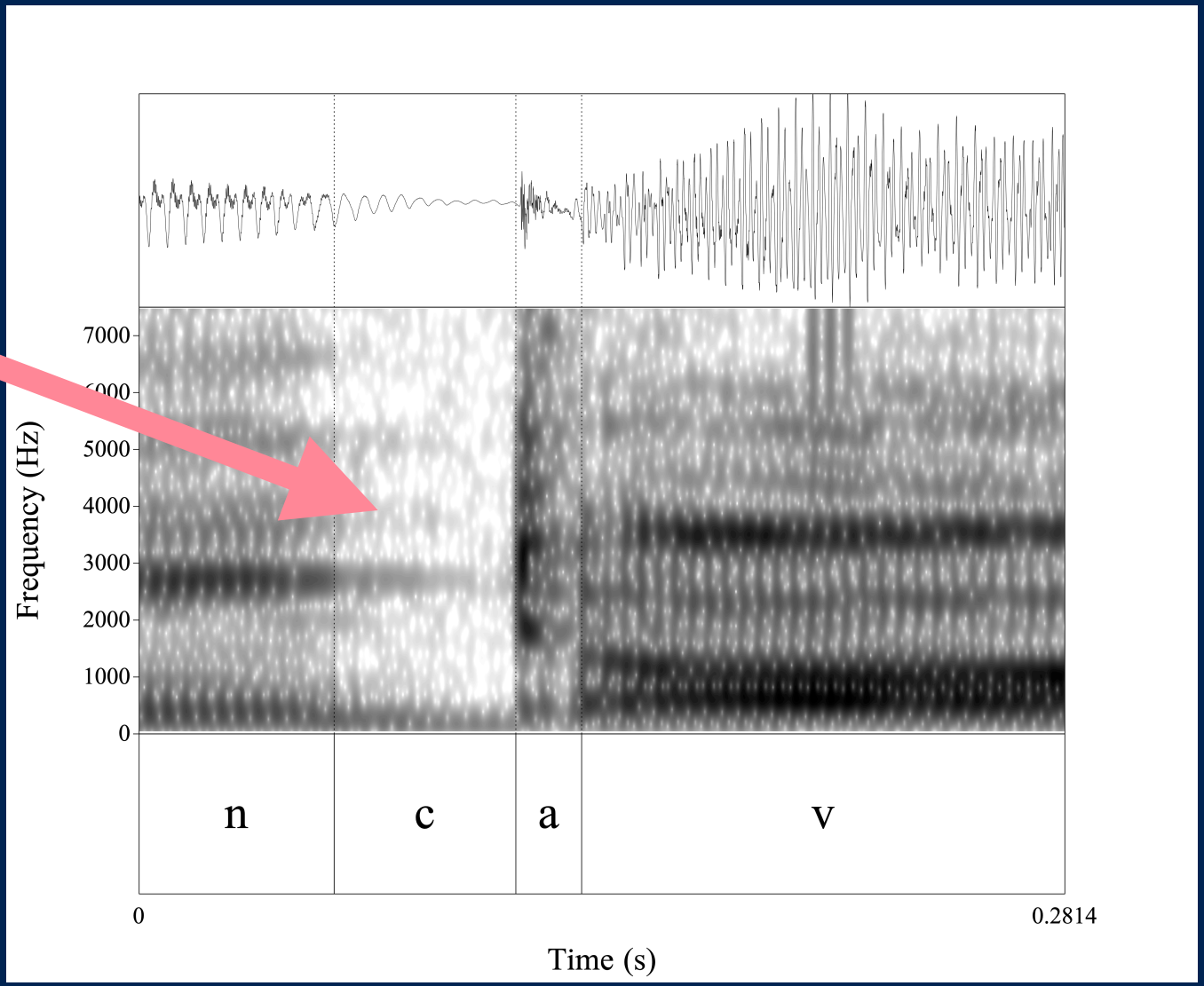
- Male, 23
- Home languages: Xhosa, English
- Bidialectal - Standard and isiMpondo

intonga (Xhosa)

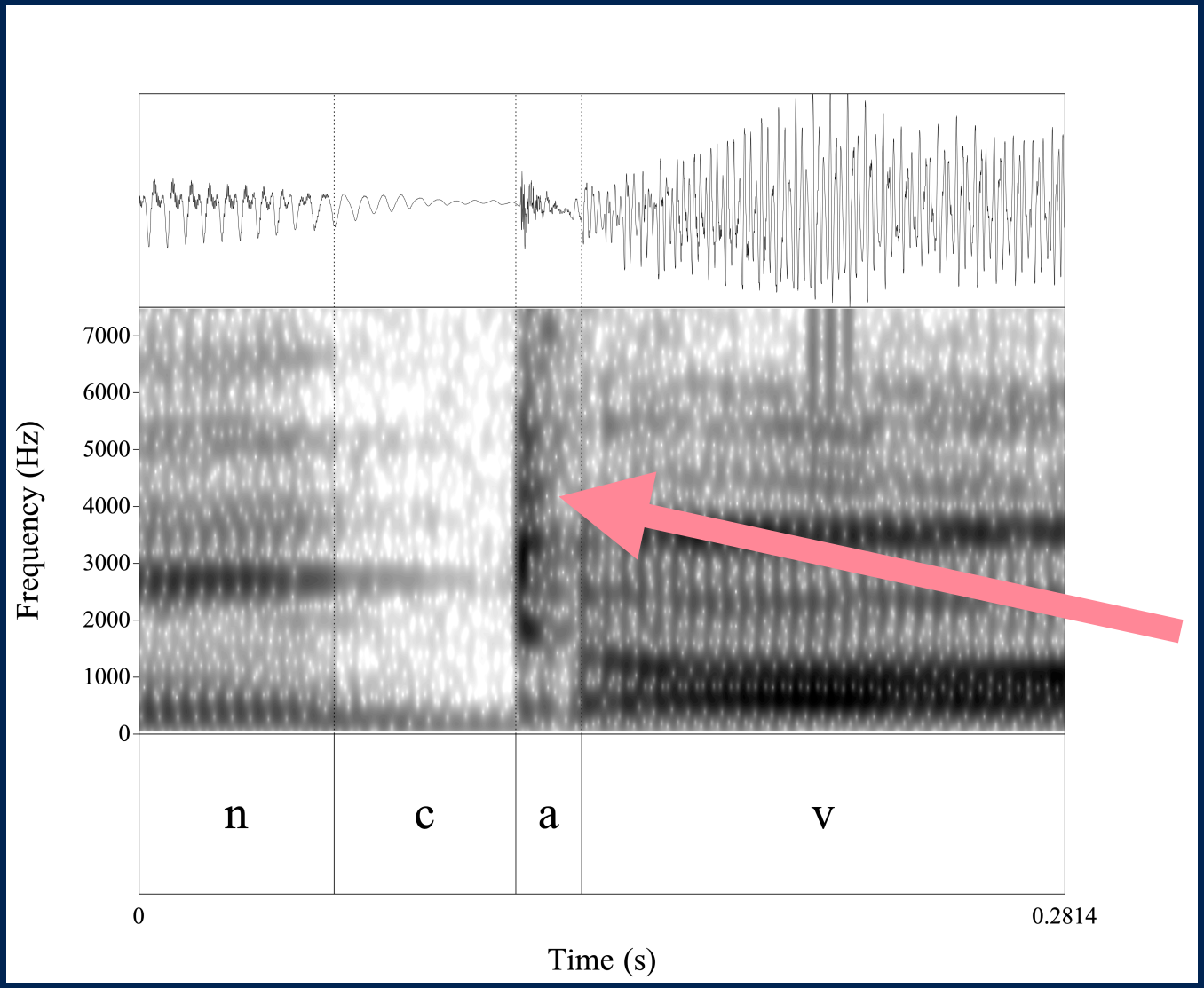


intonga (Xhosa)

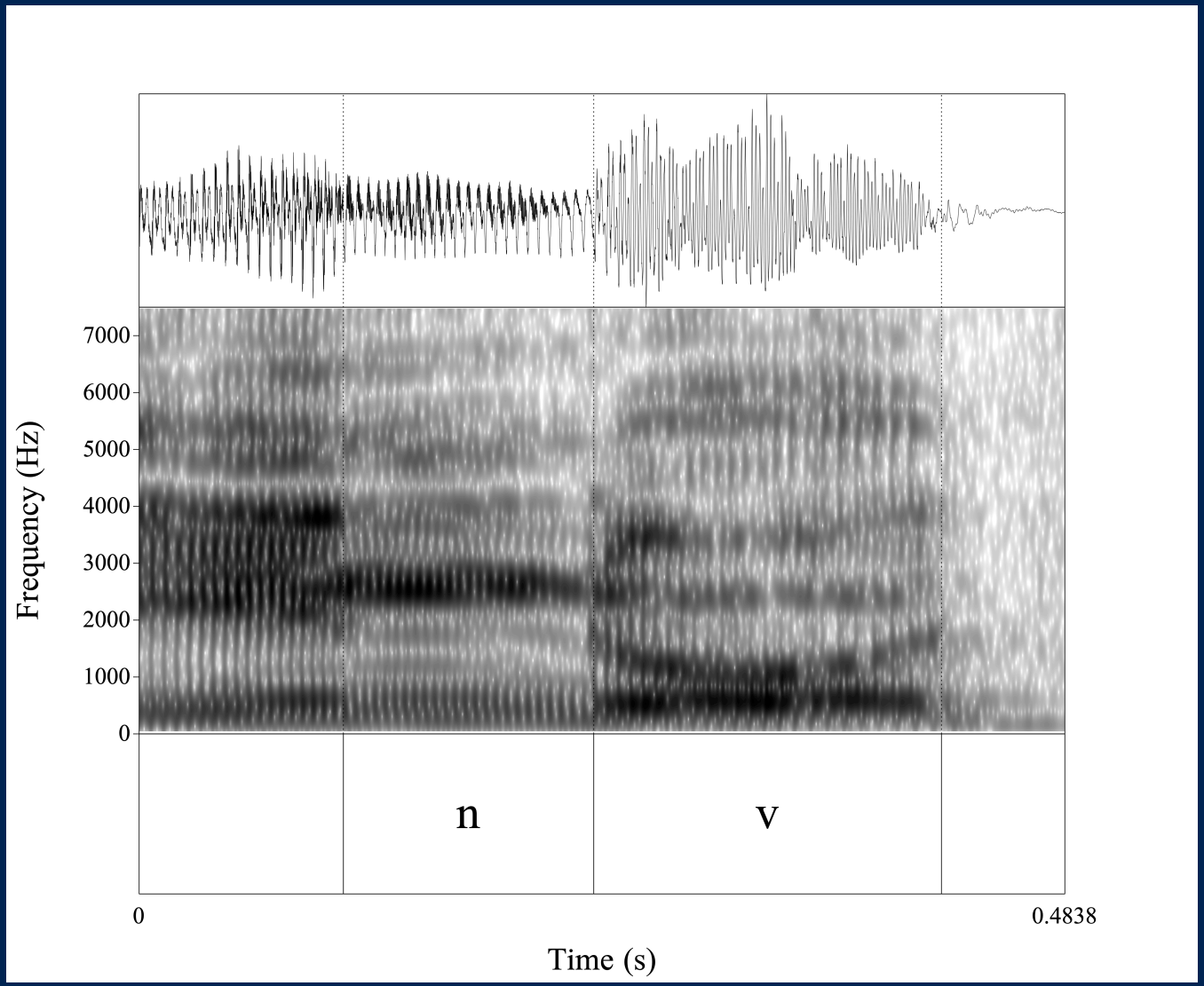
Clear closure



intonga (Xhosa)

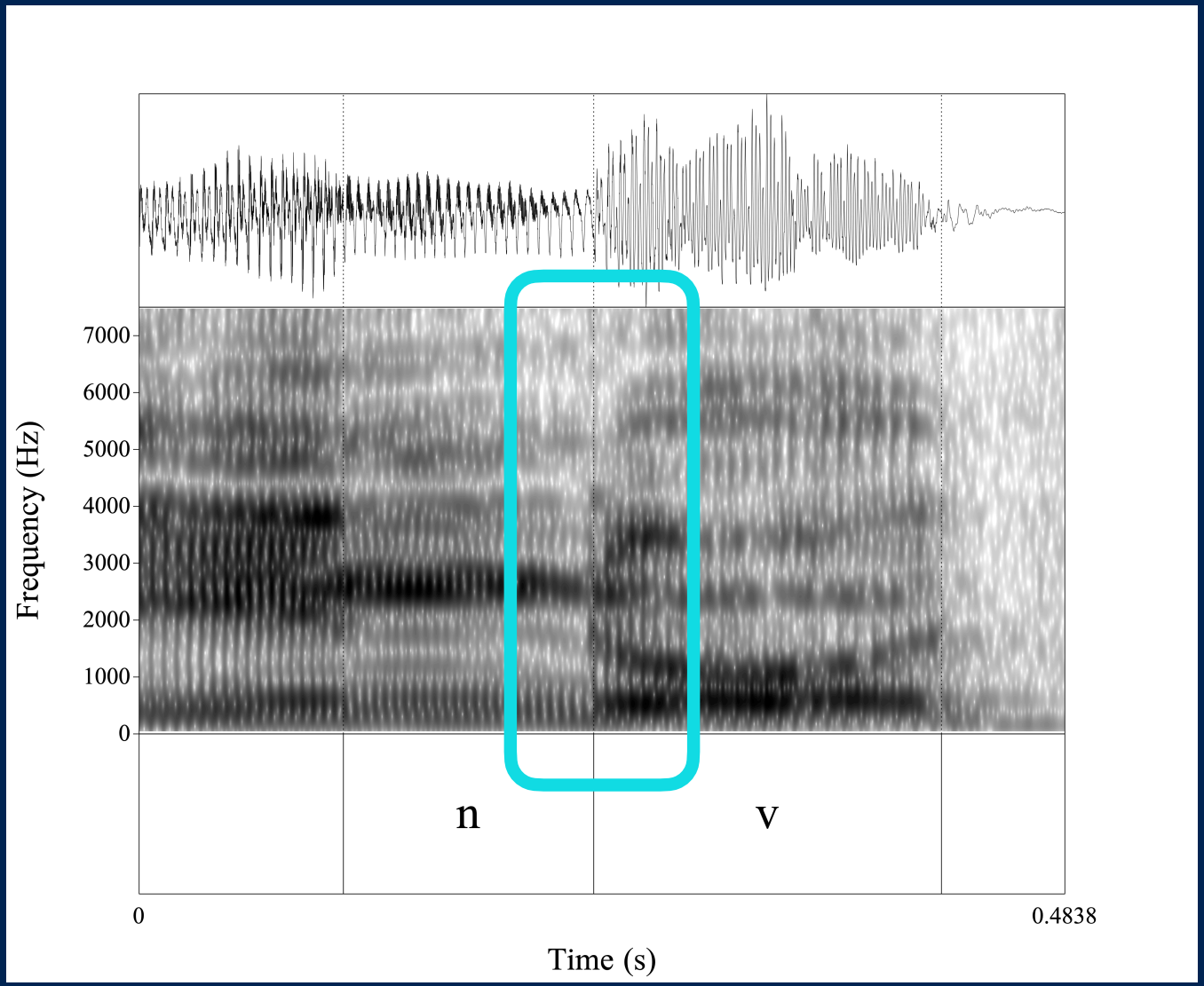


indoda (Xhosa)

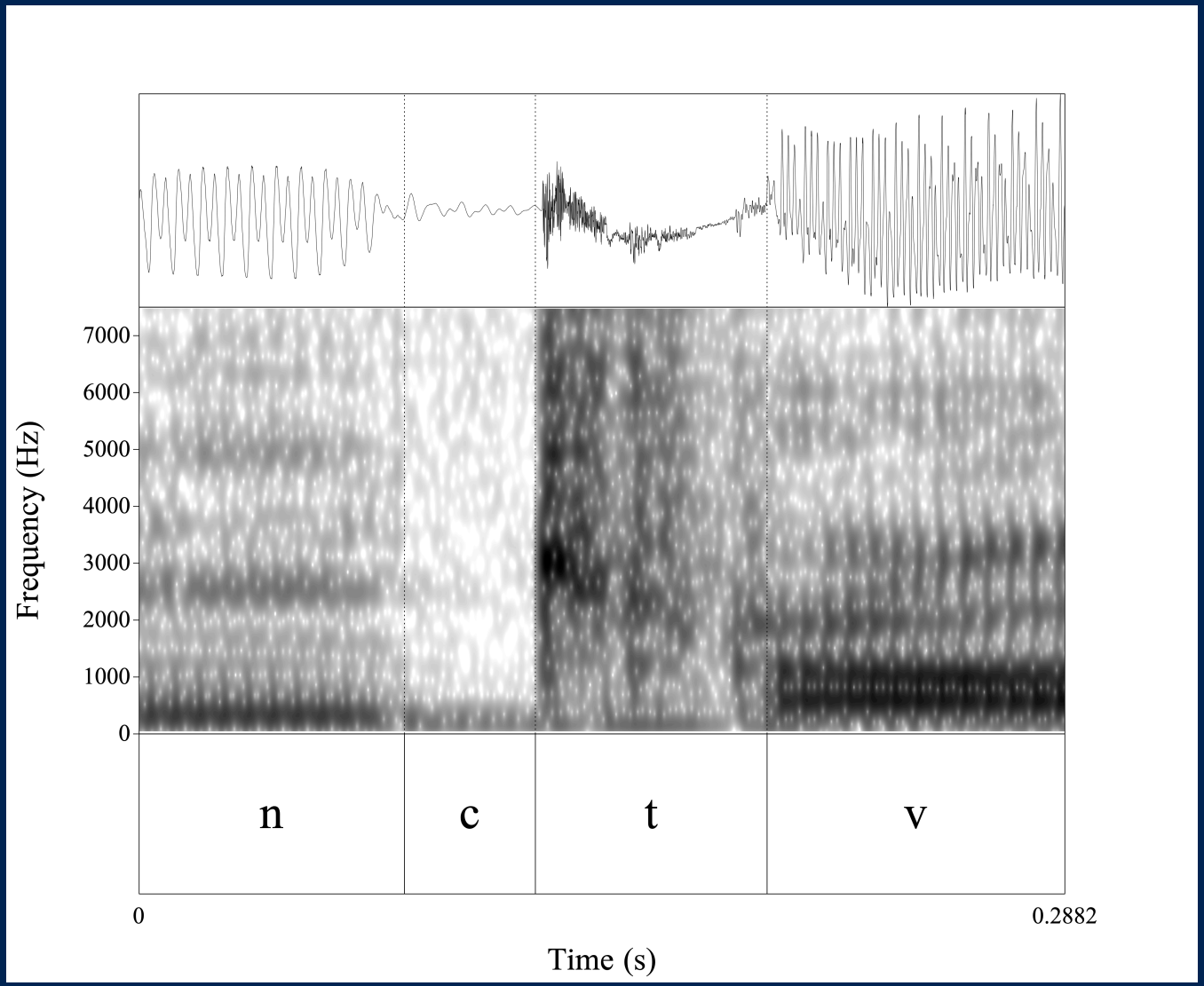


indoda (Xhosa)

No clear closure in many tokens

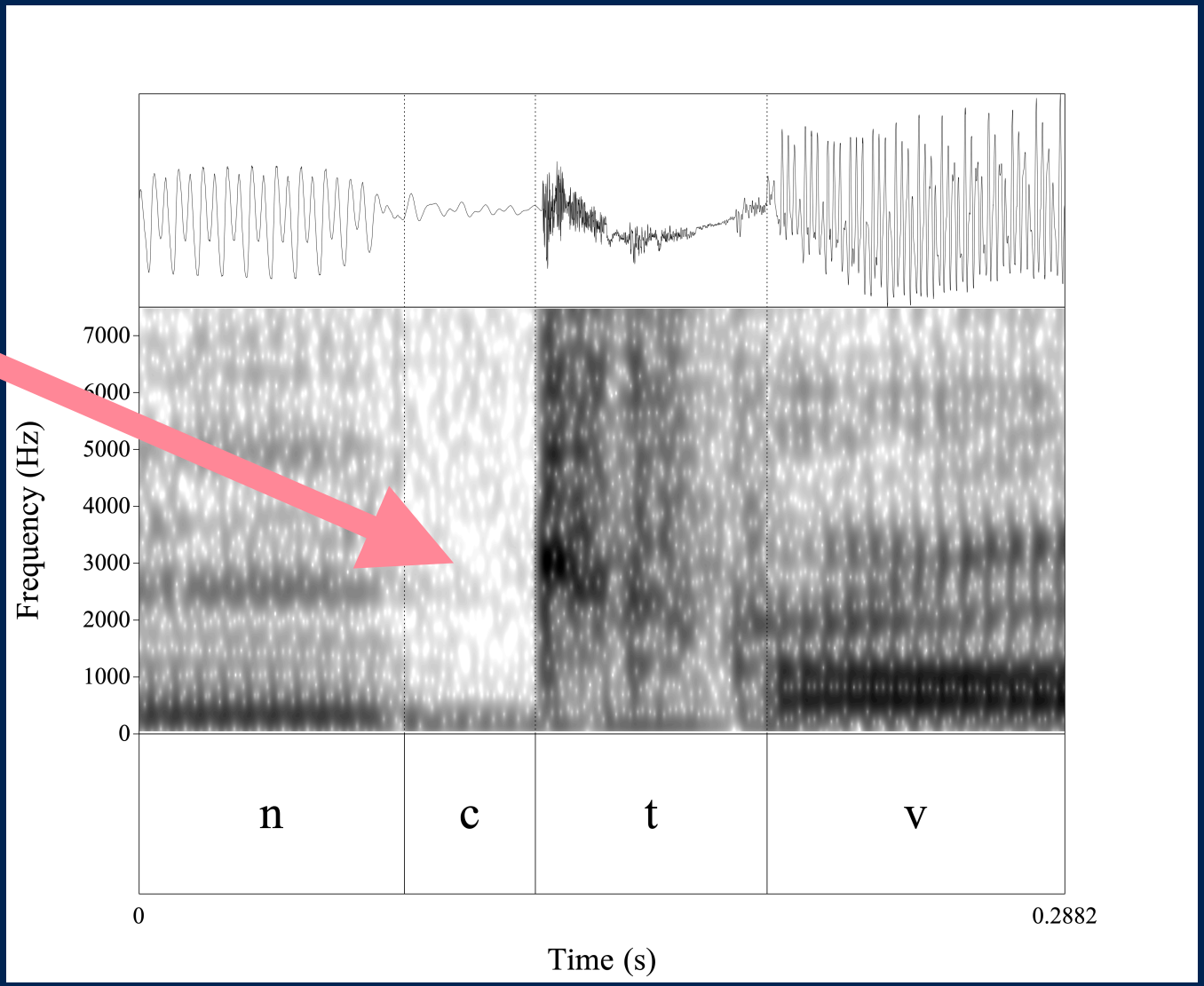


intronga (Mpondo)

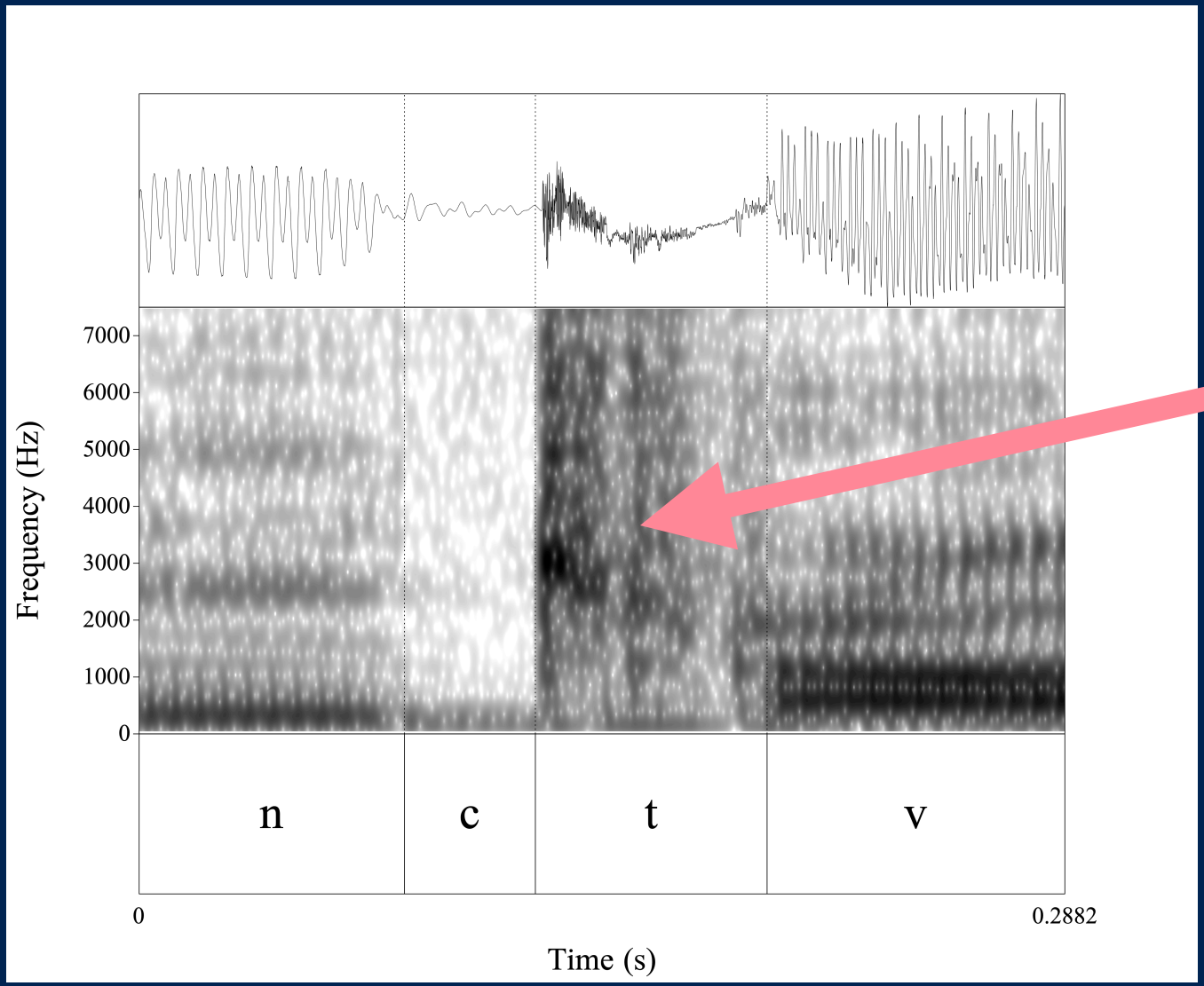


intronga (Mpondo)

Clear initial closure

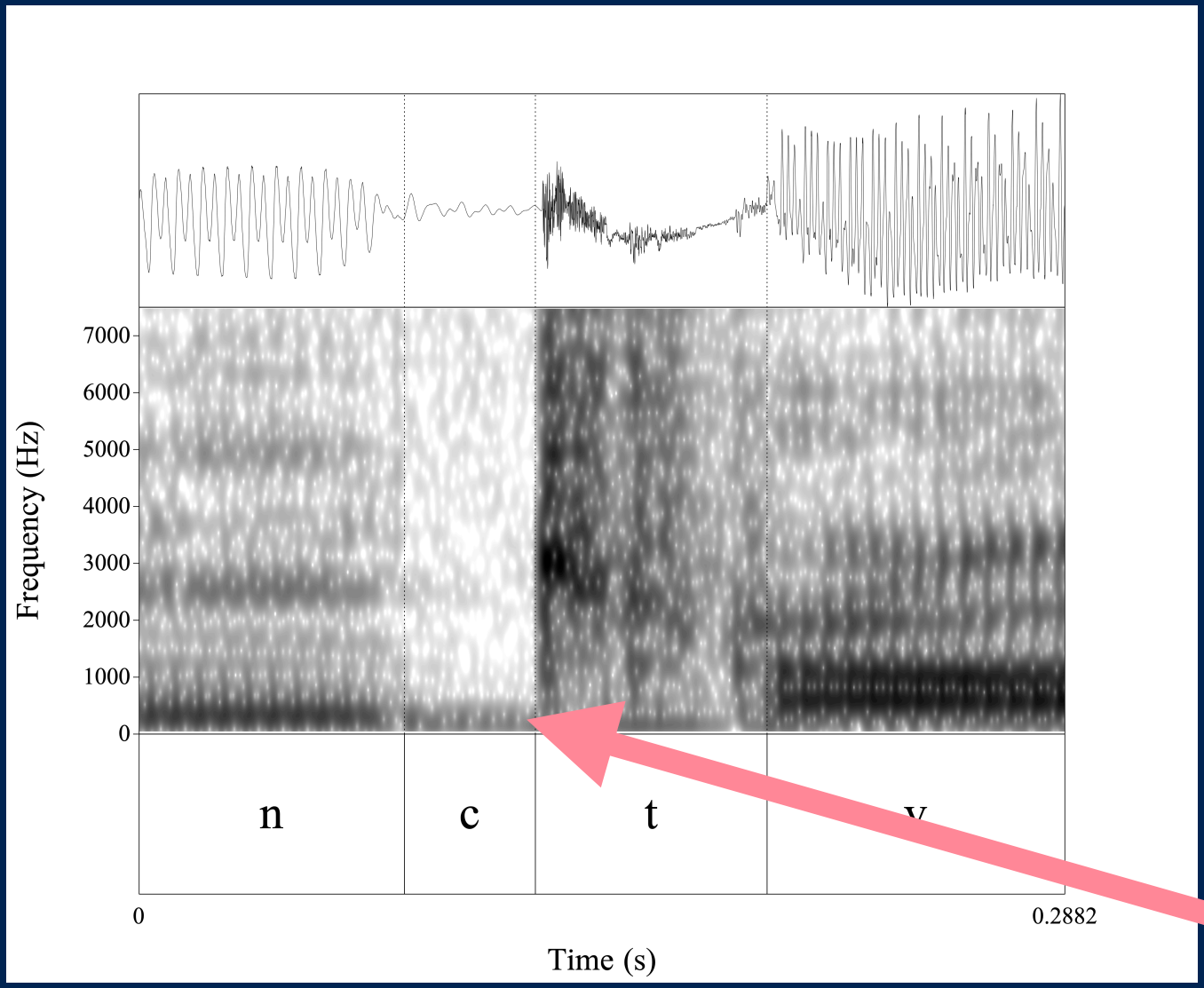


intronga (Mpondo)



Multiple closures

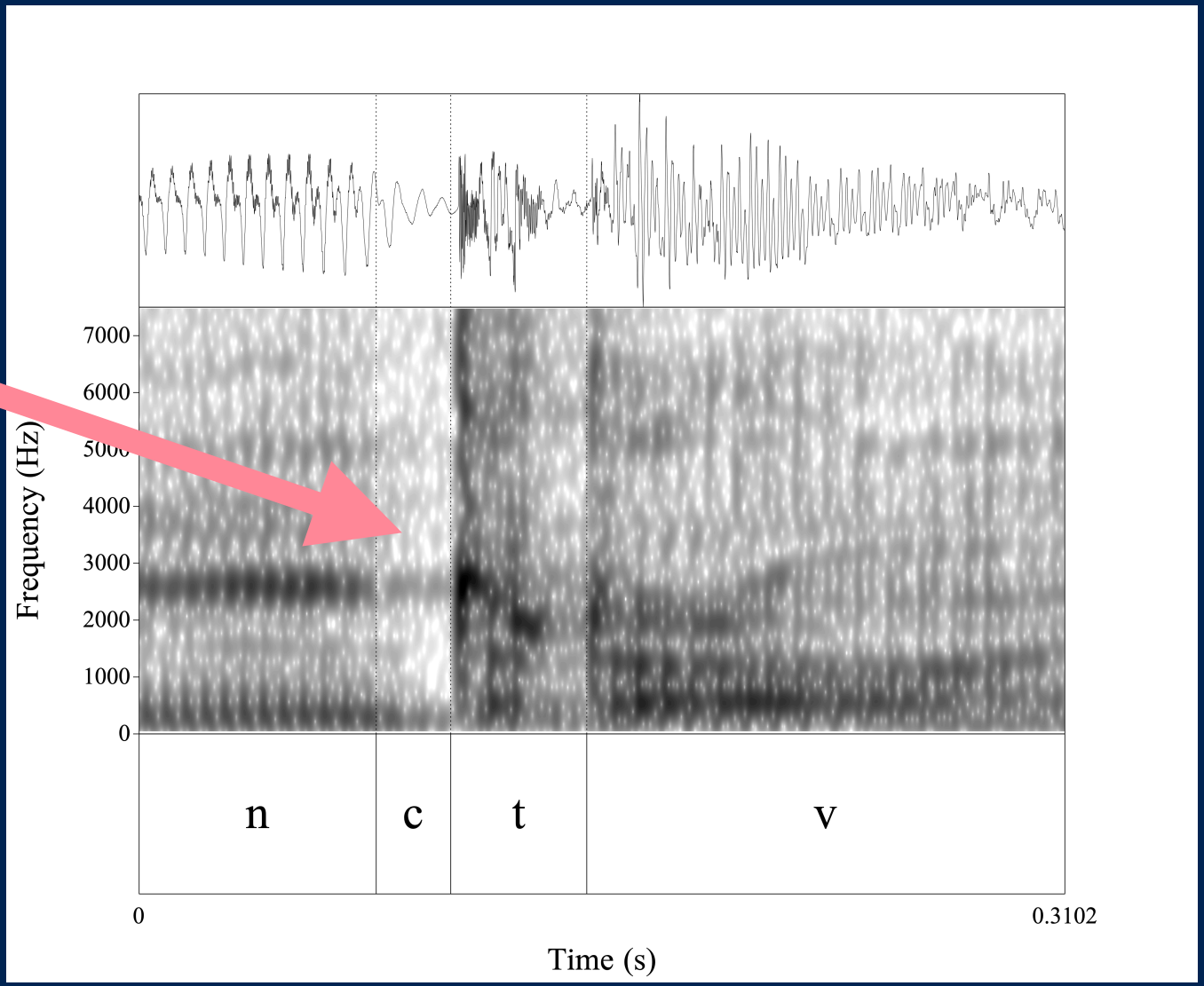
intronga (Mpondo)



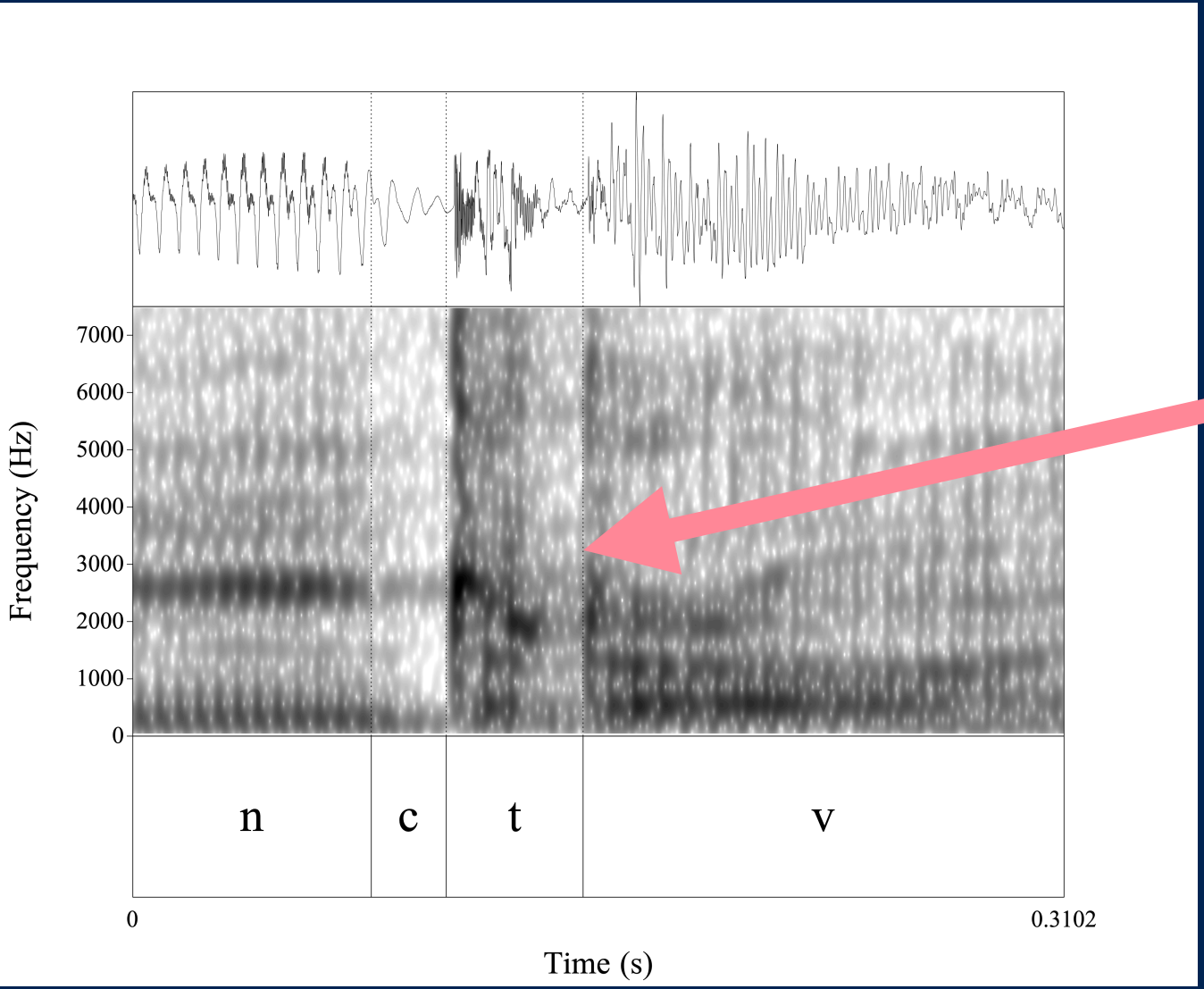
Some voicing in closure

indroda (Mpondo)

Initial closure

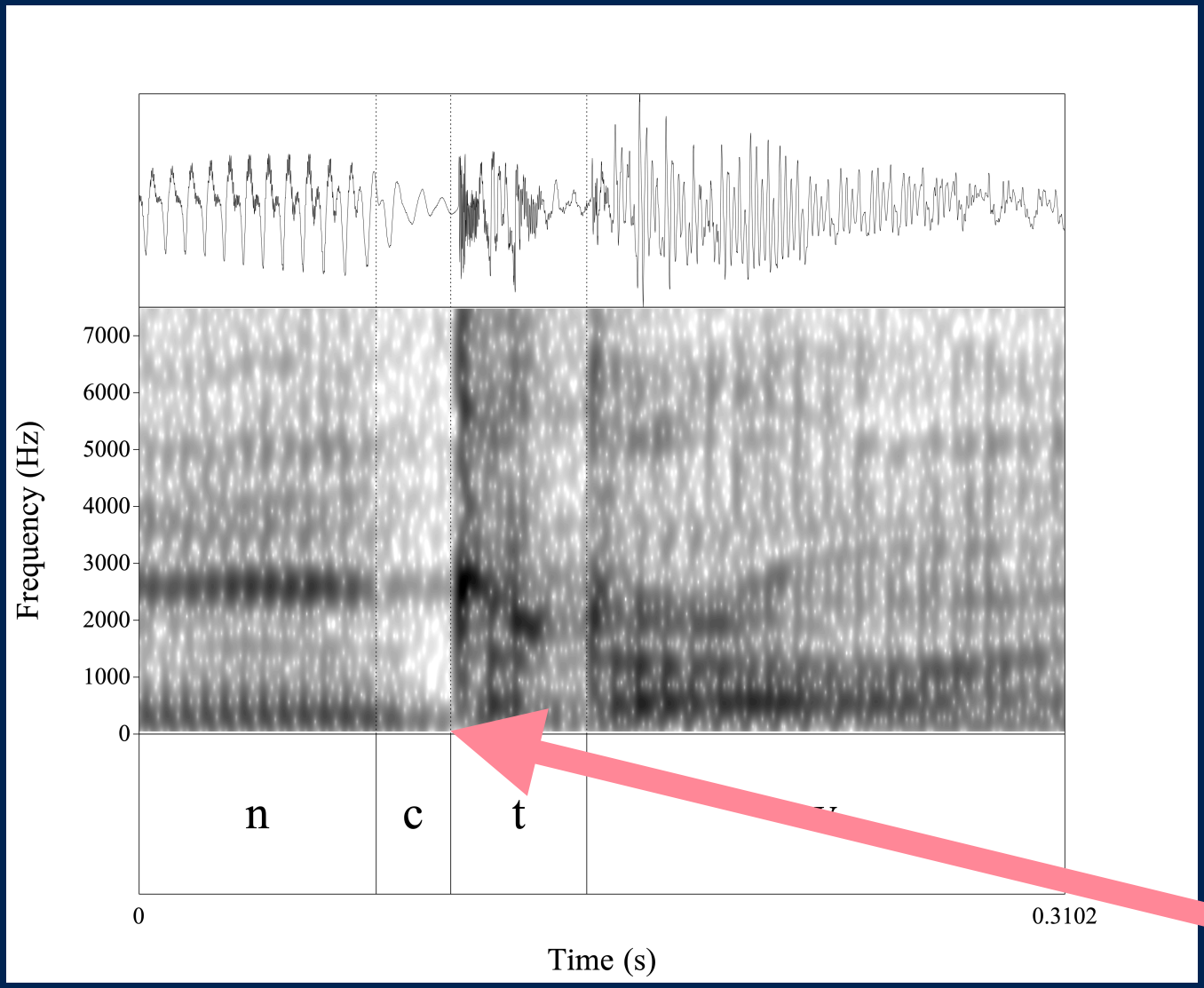


indroda (Mpondo)



Multiple closures

indroda (Mpondo)



More voicing in closure?

Measures: Acoustic

- Closure duration
- Percent voicing in closure

Measures: EGG periodicity

- Harmonics-to-noise-ratio (HNR)
- Jitter
- Pulses per second
- Percent voicing

Analysis

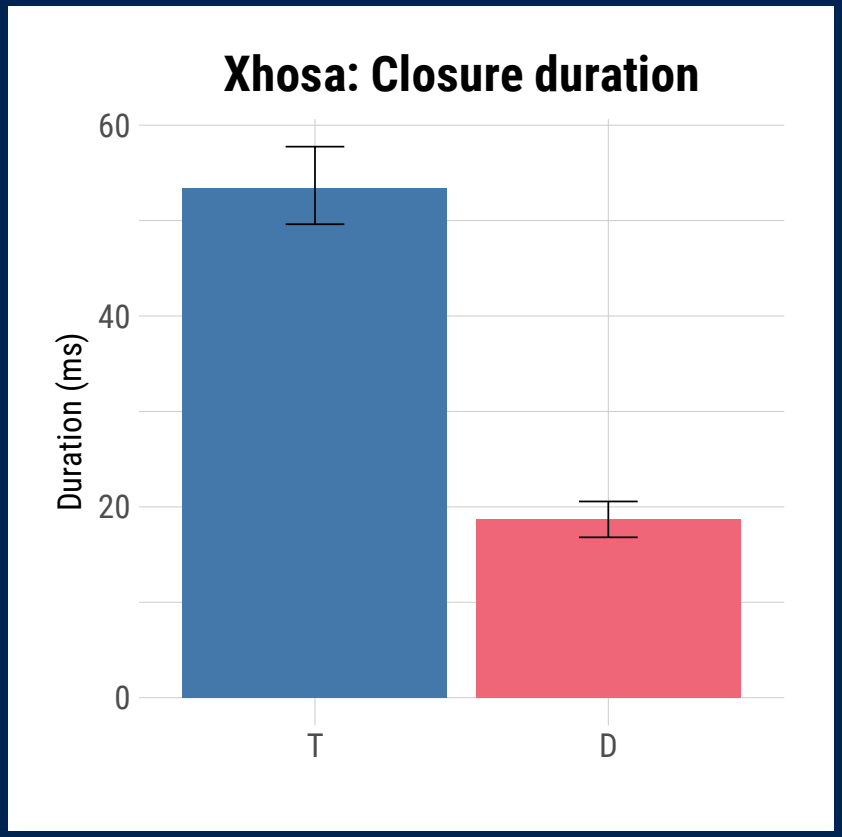
- Linear mixed model in R, using *lme4*
- Minimal model with acoustic/EGG measure as dependent variable, fixed effect of segment*, random effect of word
- In cross-lect analysis, included fixed interaction term between segment and lect*
- p-values from *lmerTest* via Satterthwaite's method

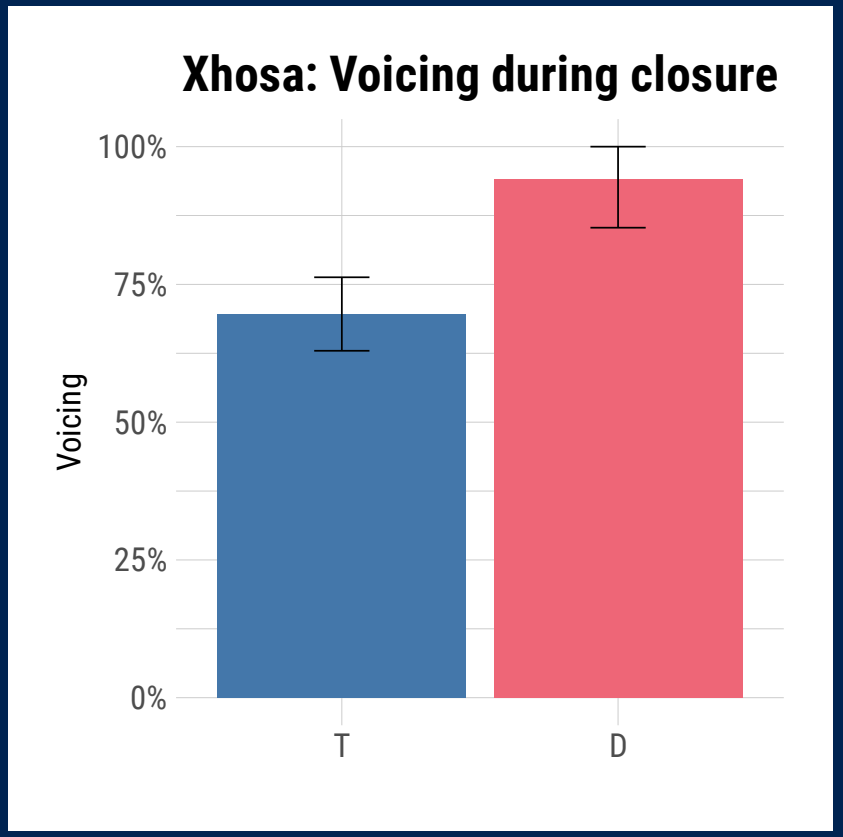
Results

Closure

A baseline: Xhosa nt/nd

Xhosa nt/nd: Acoustic

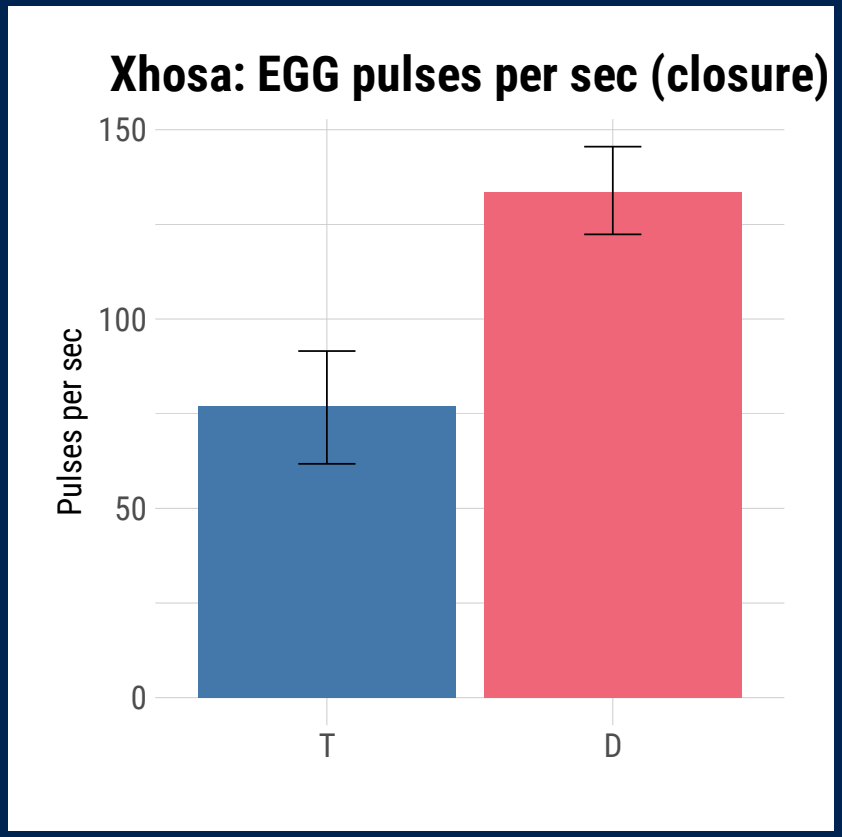


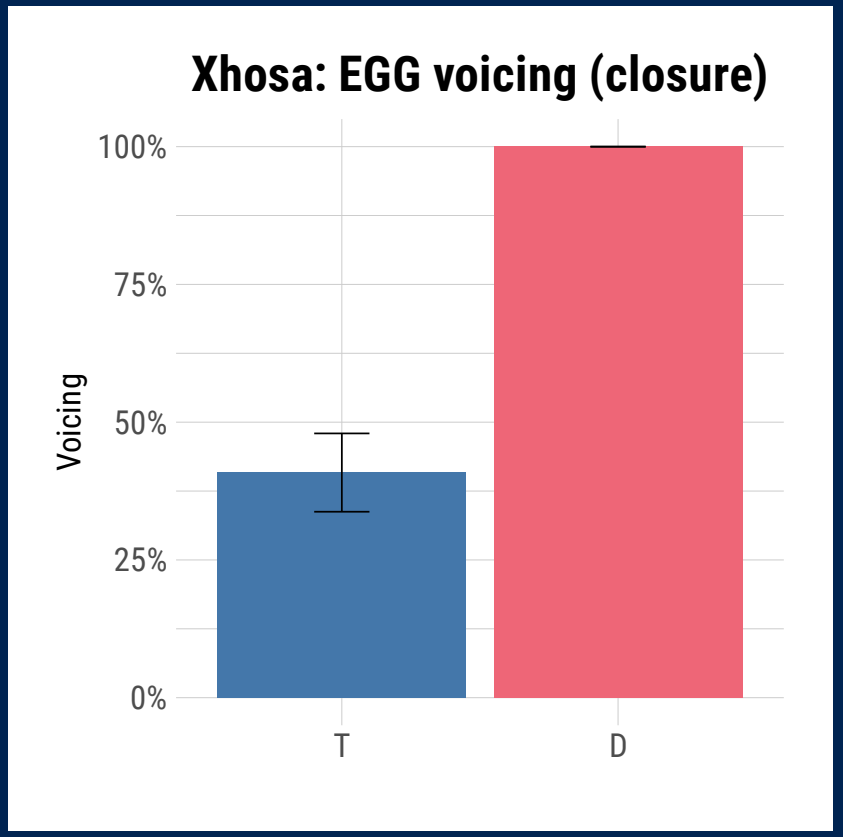


β = -34.471, SE = 3.620,
t(21.061) = -9.524, p < 0.001***

β = 0.244, SE = 0.053, t(72)
= 4.599, p < 0.001***

Xhosa nt/nd: EGG

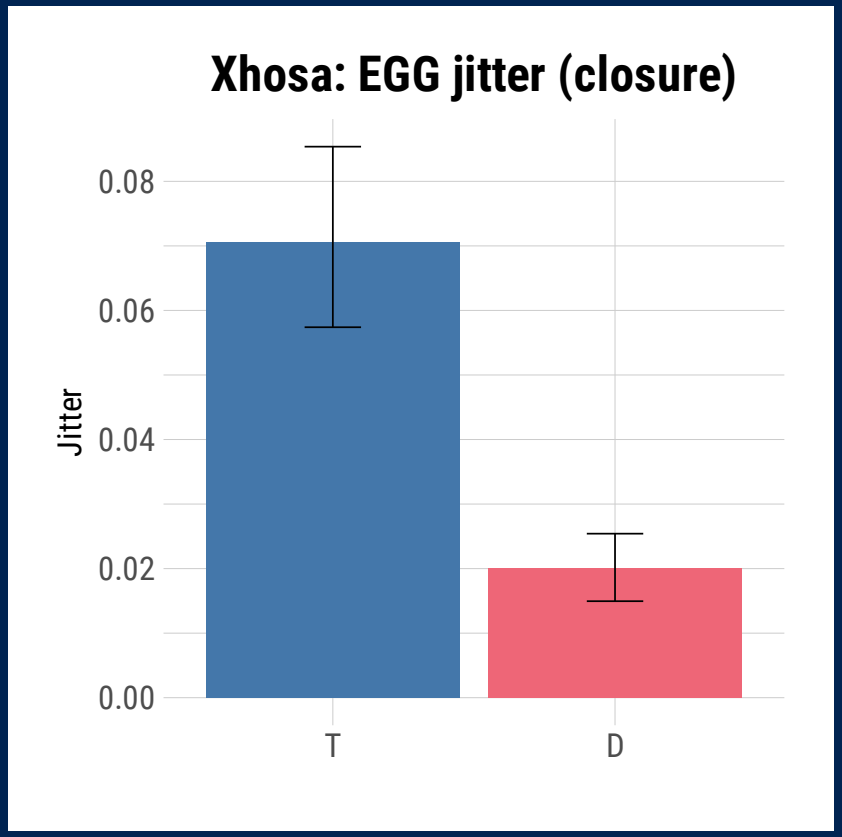


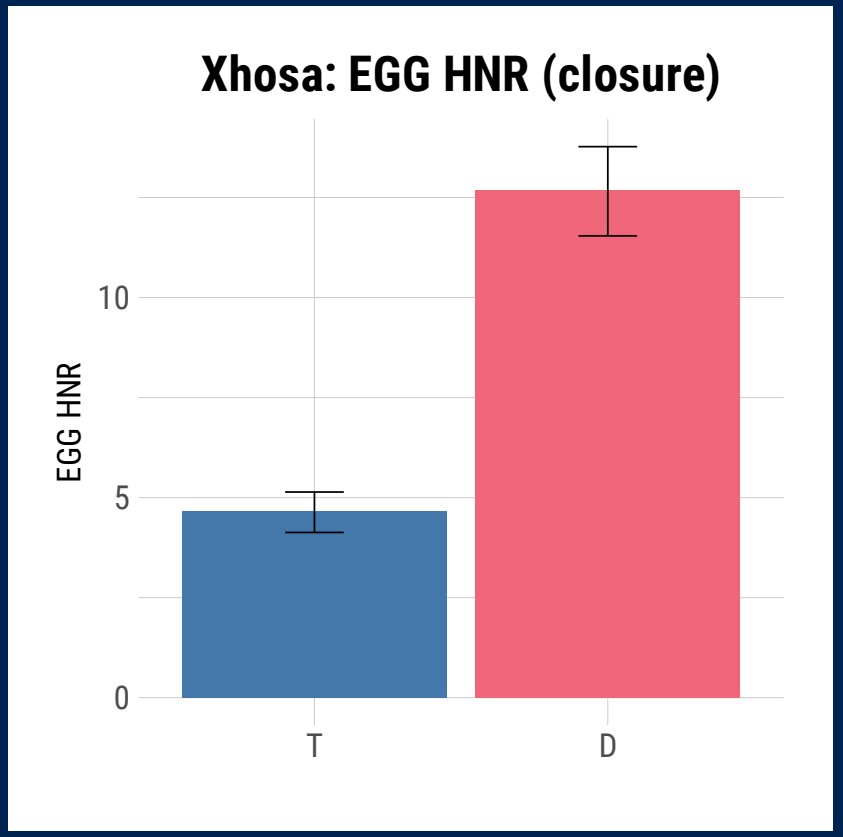


β = 54.904, SE = 13.381,
t(18.567) = 4.103, p < 0.001***

β = 0.59, SE = 13.381,
t(18.567) = 4.103, p < 0.001***

Xhosa nt/nd: EGG



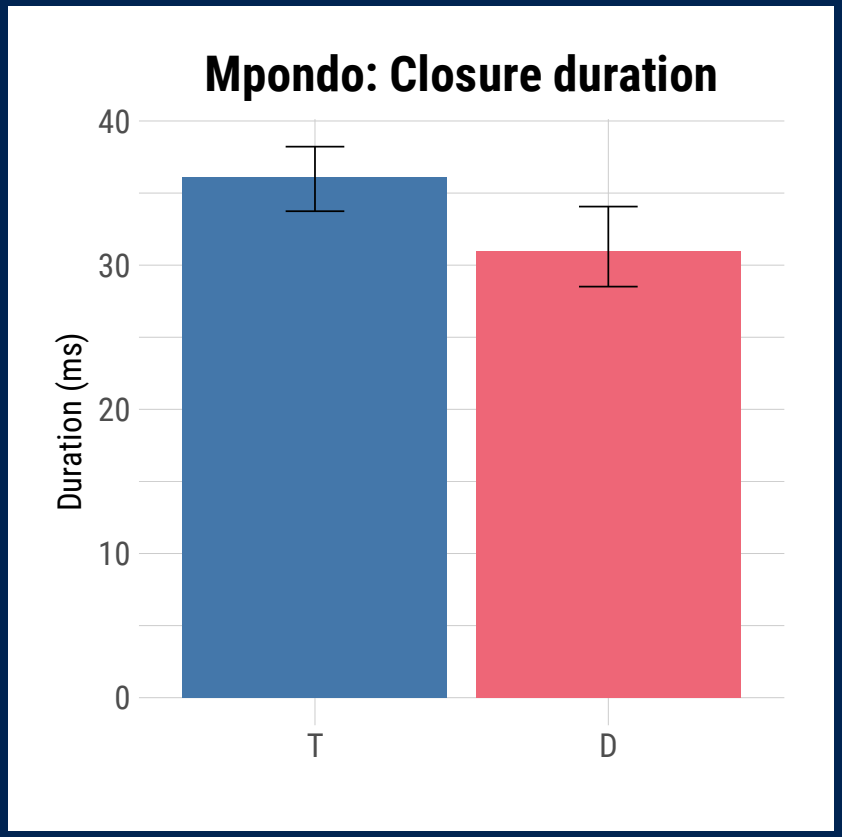


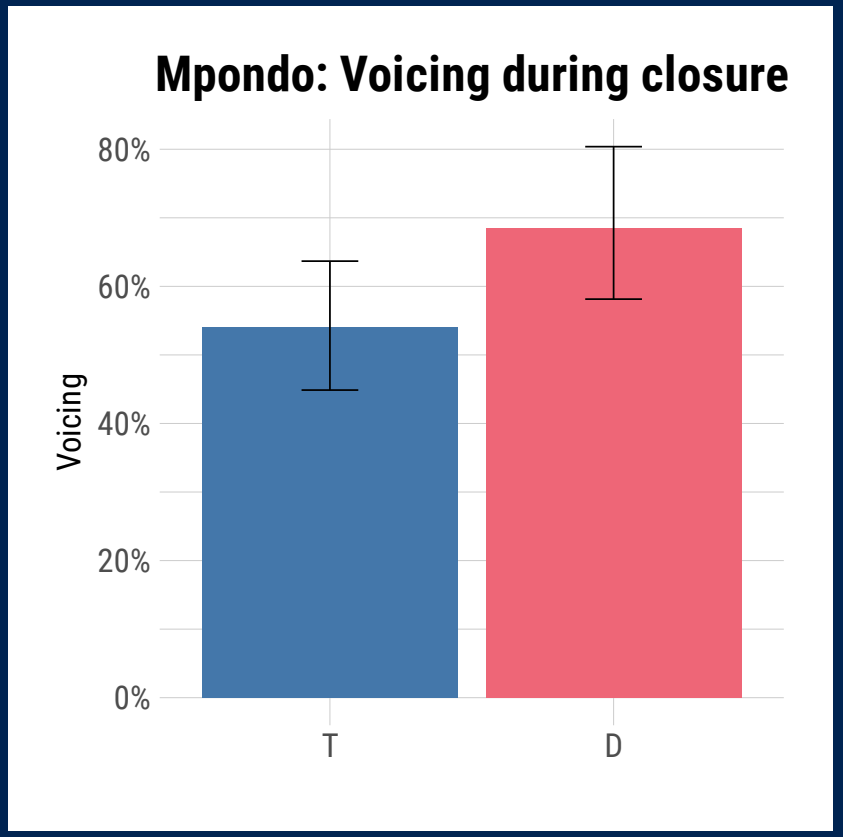
β = -0.051, SE = 0.012,
t(13.134) = -4.368, p < 0.001***

β = 7.746, SE = 0.904,
t(12.577) = 8.566, p < 0.001***

Mpondo ntr/ndr

Mpondo ntr/ndr: Acoustic

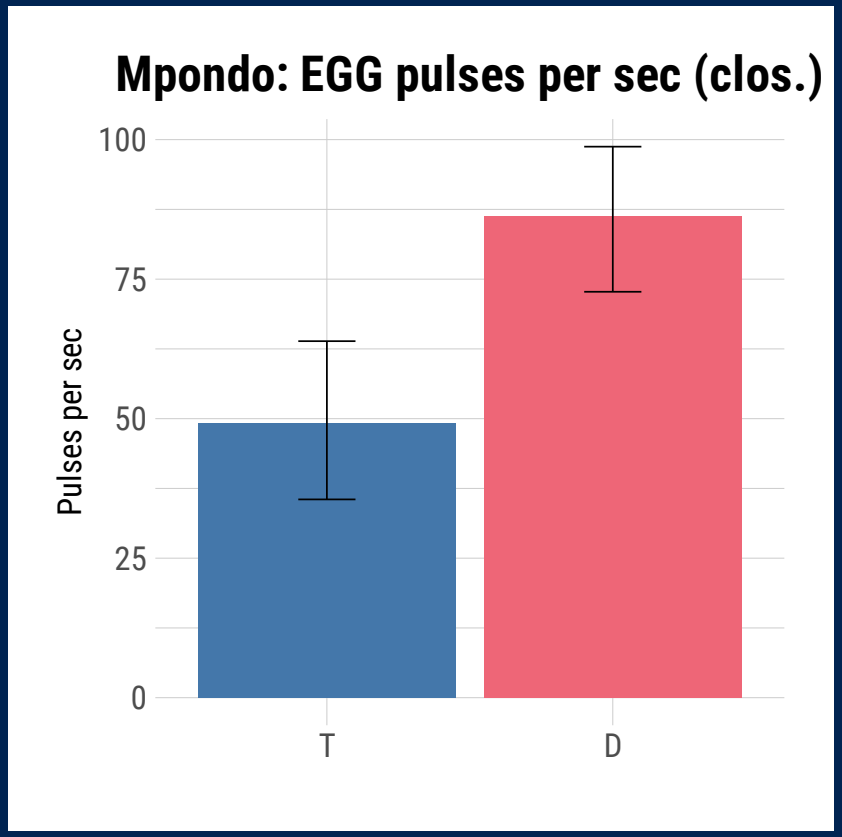


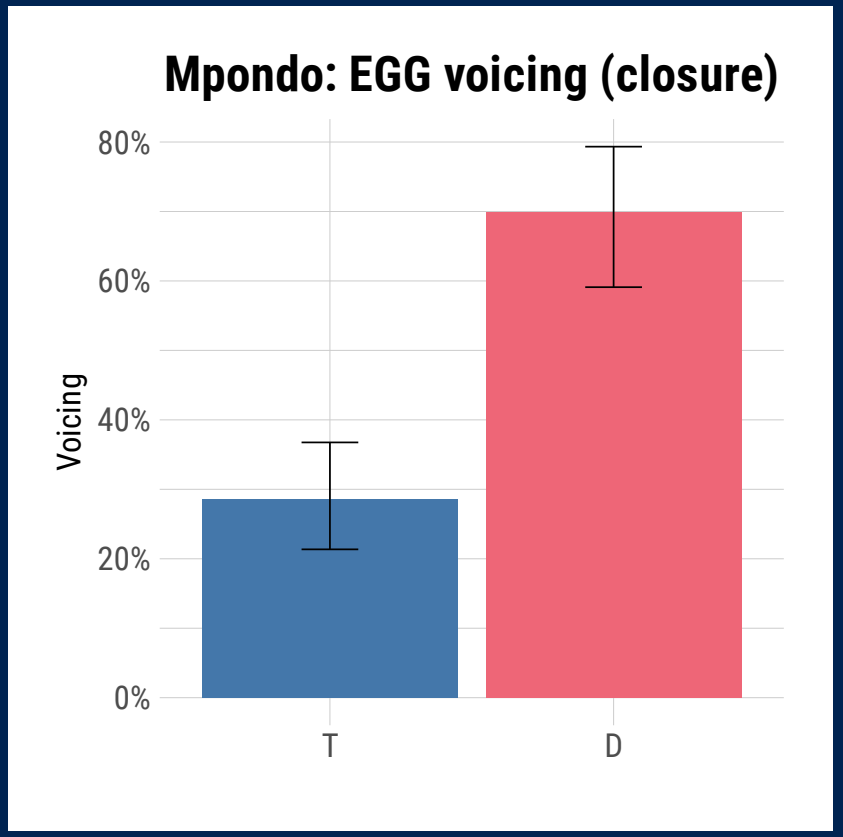


β = -5.341, SE = 2.344,
t(18.144) = 1.409, p = 0.176

β = 0.244, SE = 0.053, t(72)
= 4.599, p < 0.001

Mpondo ntr/ndr: EGG

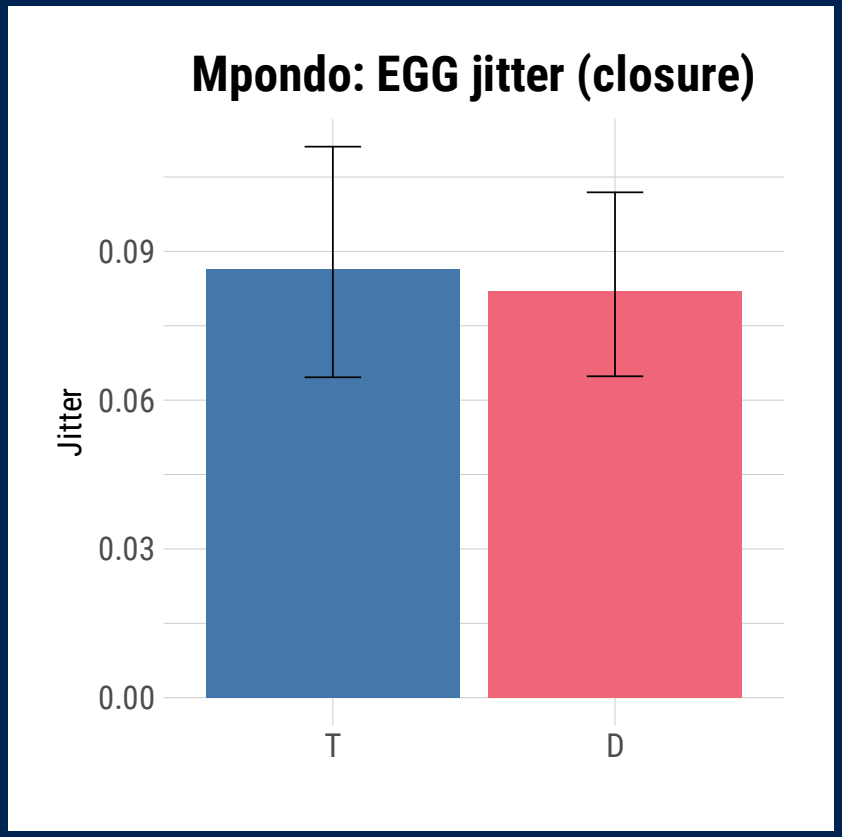


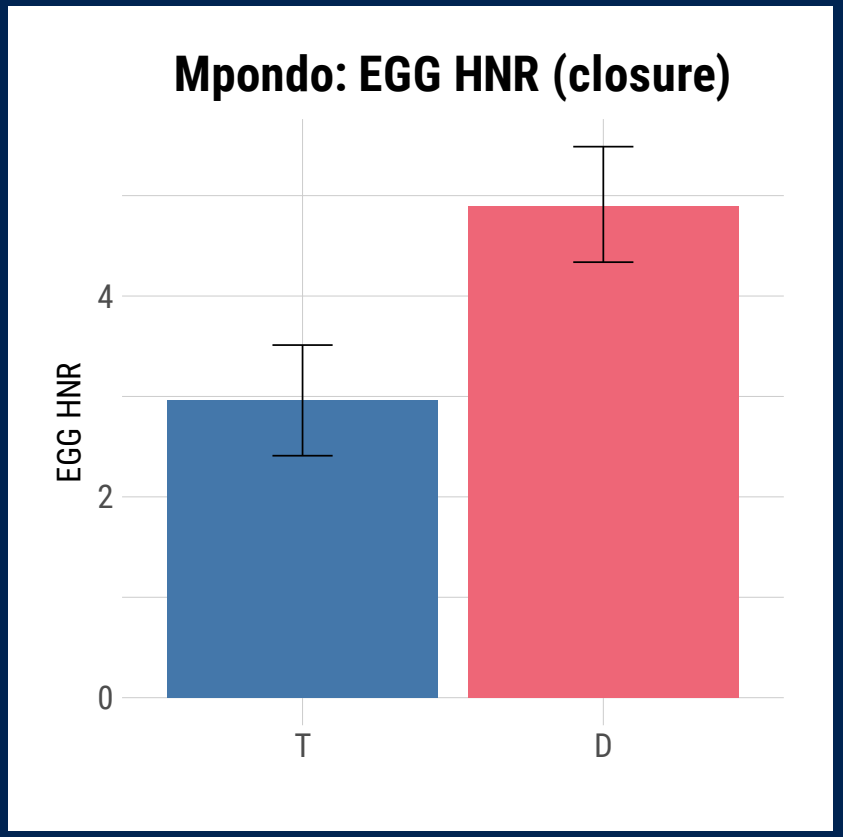


β = 35.863, SE = 12.807,
t(18.454) = 2.800, p = 0.012*

β = 0.398, SE = 0.092,
t(17.621) = 4.345, p < 0.001***

Mpondo ntr/ndr: EGG



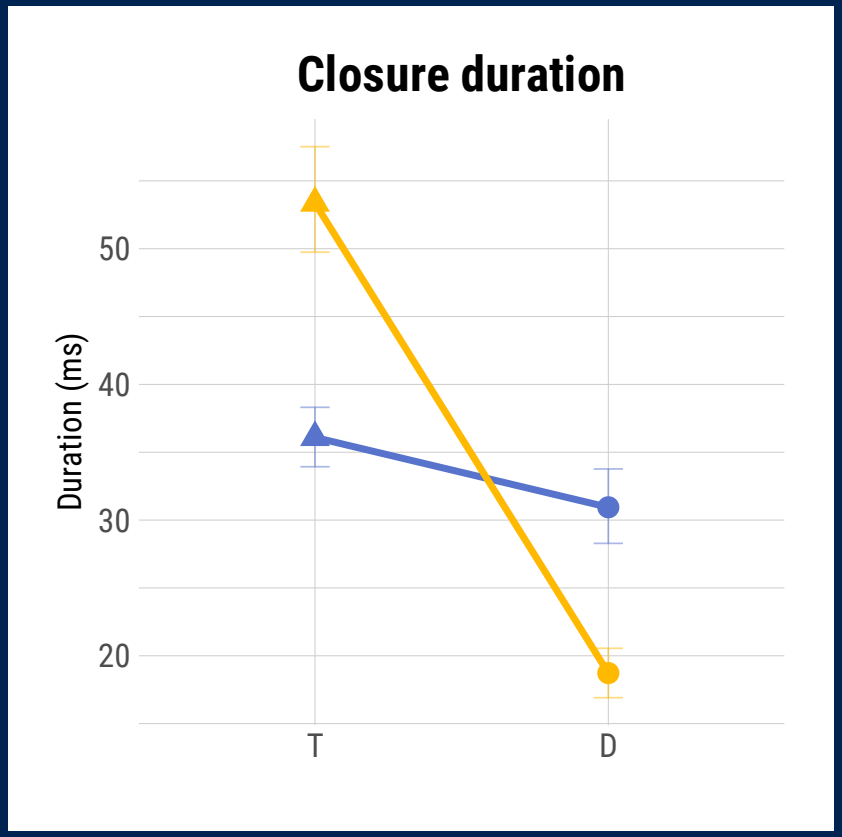


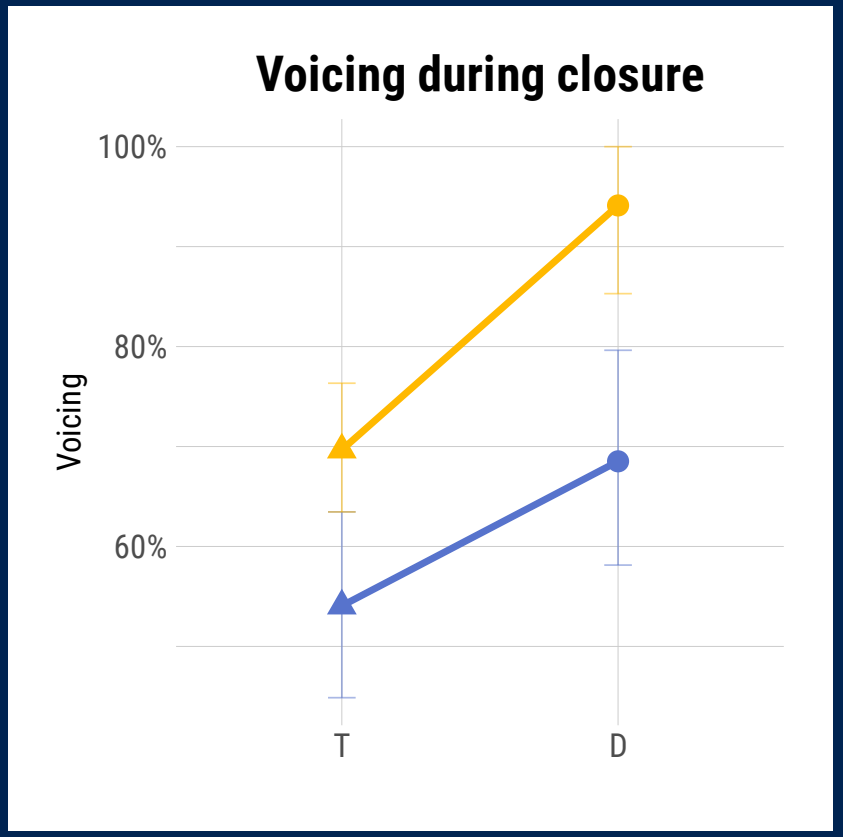
β = -0.04, SE = 0.020,
t(13.365) = -0.199, p = 0.854

β = 1.917, SE = 0.443,
t(19.103) = 4.327, p < 0.001***

Comparing closures across lects

Across lects: Acoustic



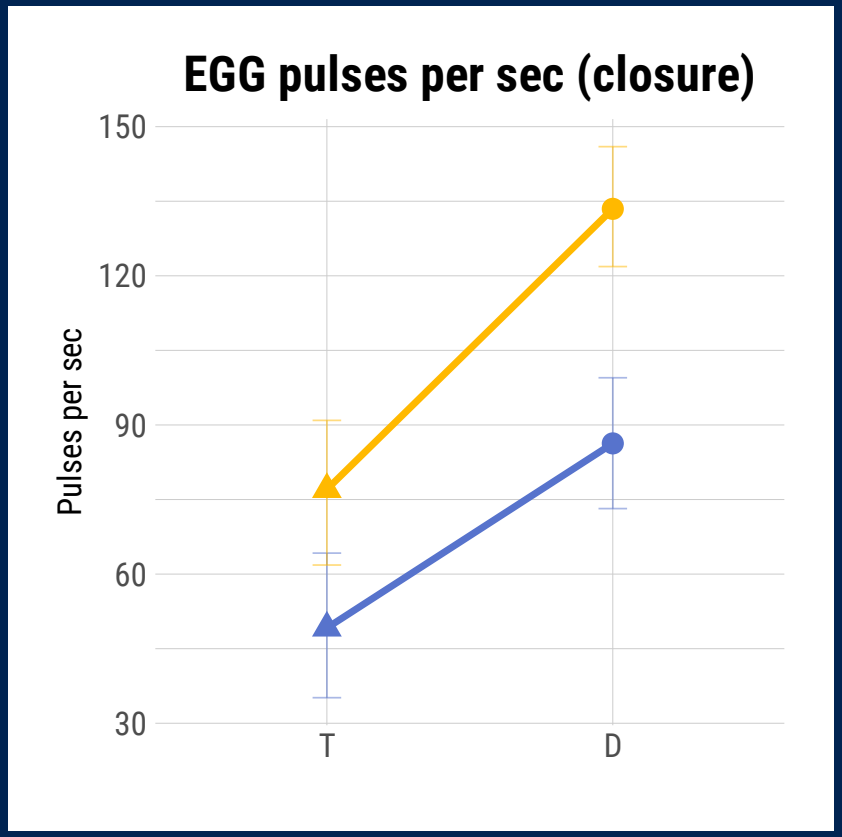


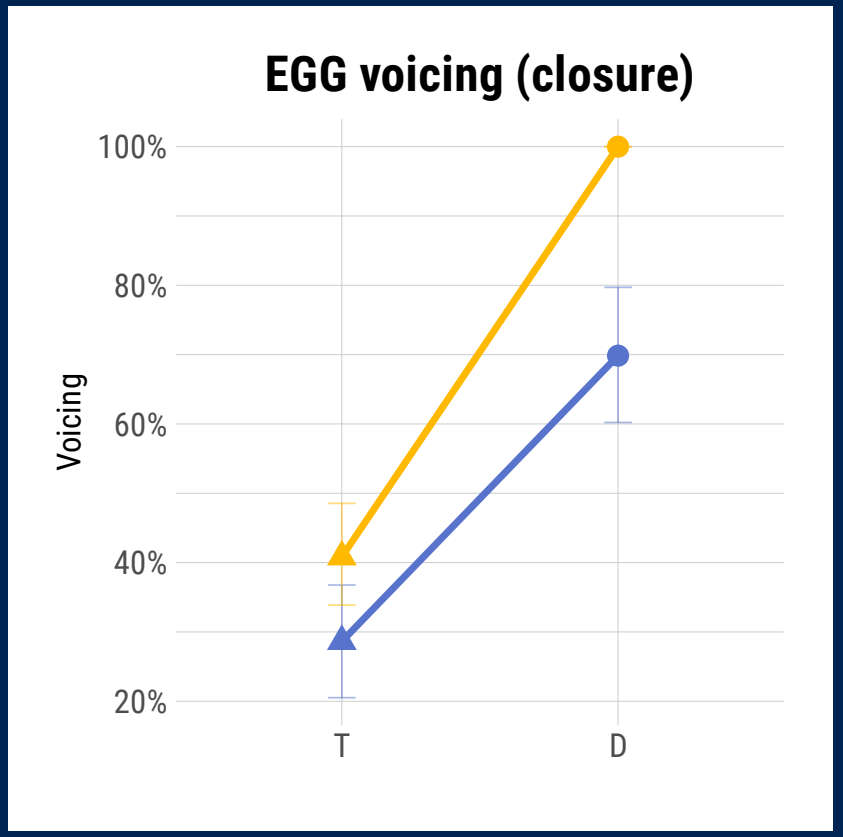
β = -28.93, SE = 2.513,
t(136.463) = -11.513, p < 0.001***

Lect
Mpondo
Xhosa

β = 0.099, SE = 0.093,
t(136.293) = 1.061, p = .291

Across lects: EGG



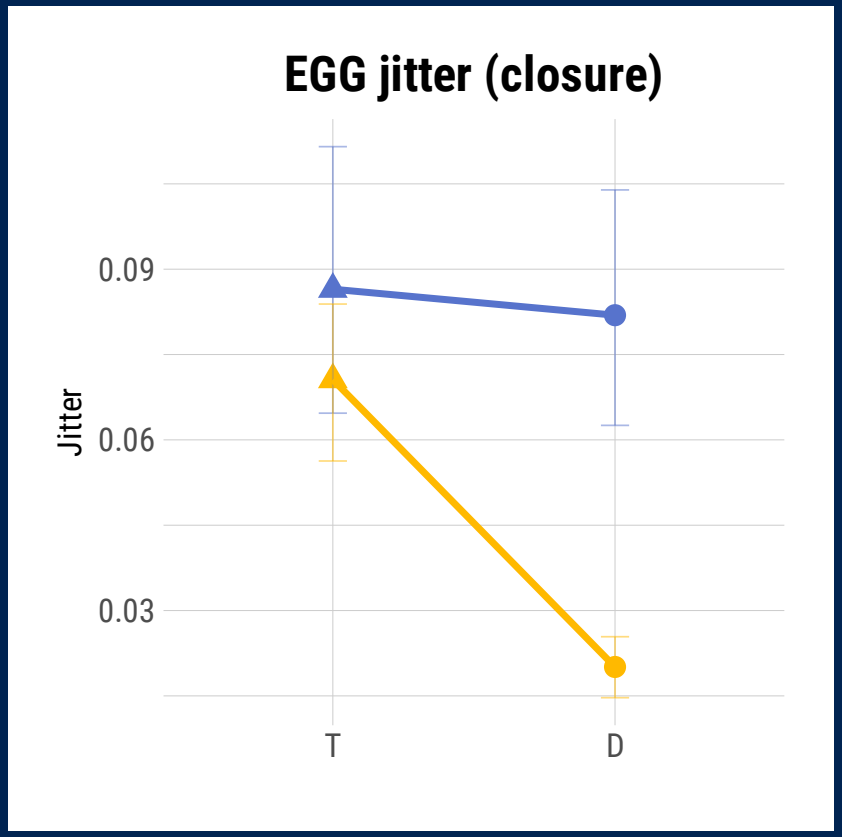


β = 16.339, SE = 12.063,
t(135.0864) = 1.354, p = 0.179

Lect
Mpondo
Xhosa

β = 0.175, SE = 0.074,
t(133.442) = 2.359, p < 0.05*

Across lects: EGG



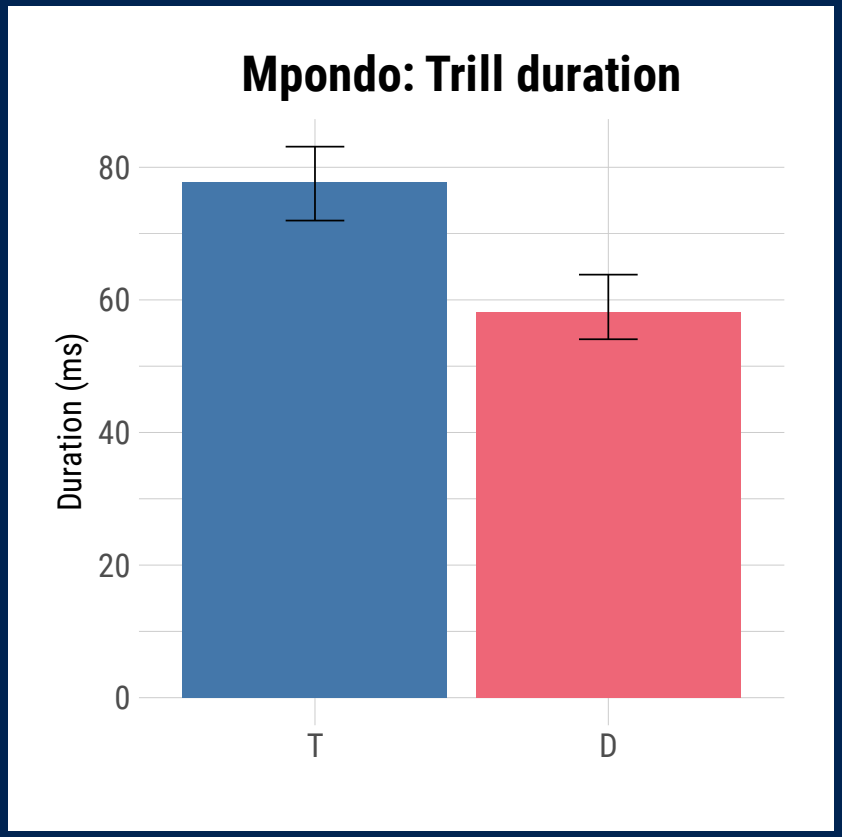
β = -28.93, SE = 2.513,
t(136.463) = -11.513, p < 0.001***

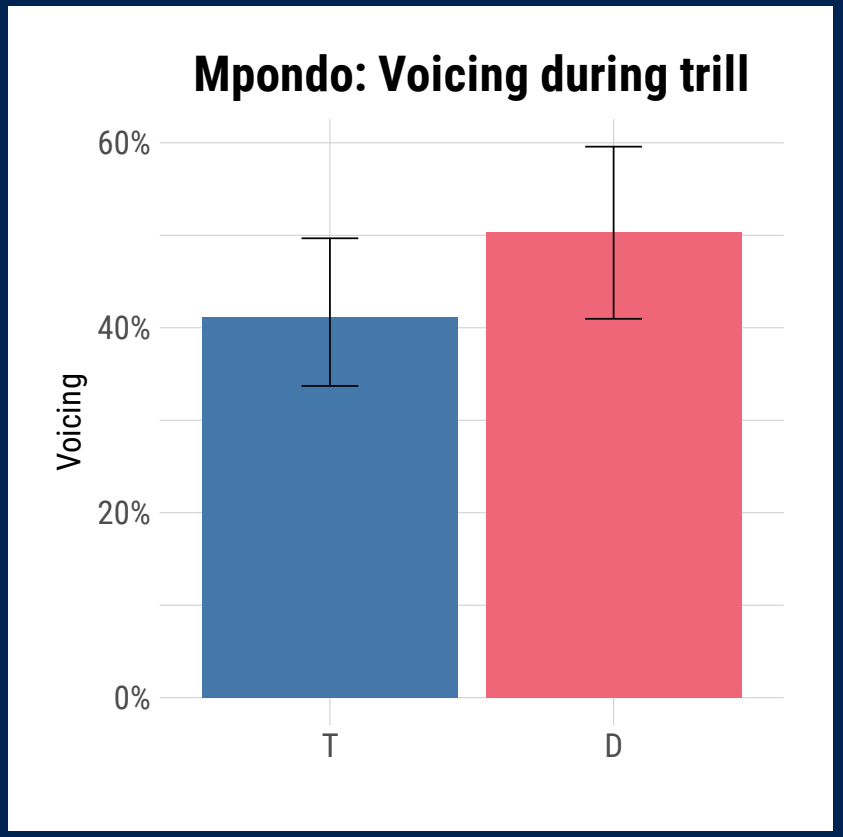
Lect
Mpondo
Xhosa

β = 6.088, SE = 0.674,
t(121.847) = 9.039, p < 0.001***

Trill portion (Mpondo only)

Trill portion: Acoustic

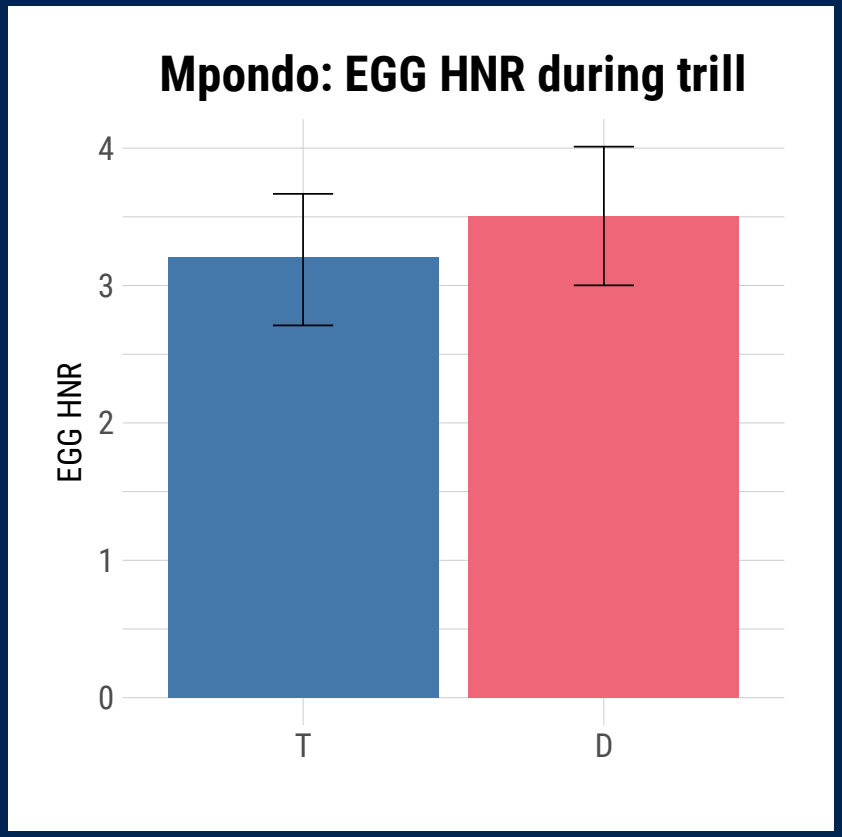


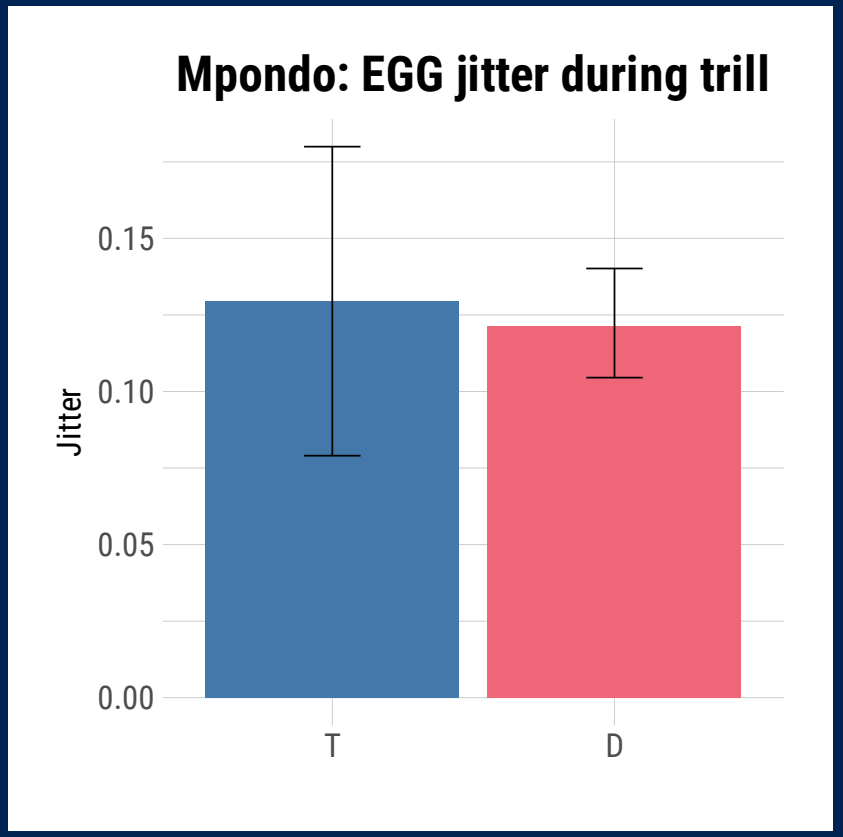


β = -19.593, SE = 5.892,
t(20.000) = -3.325, p < 0.005**

β = 0.092, SE = 0.086
t(20.000) = 1.072, p = 0.29

Trill portion: EGG

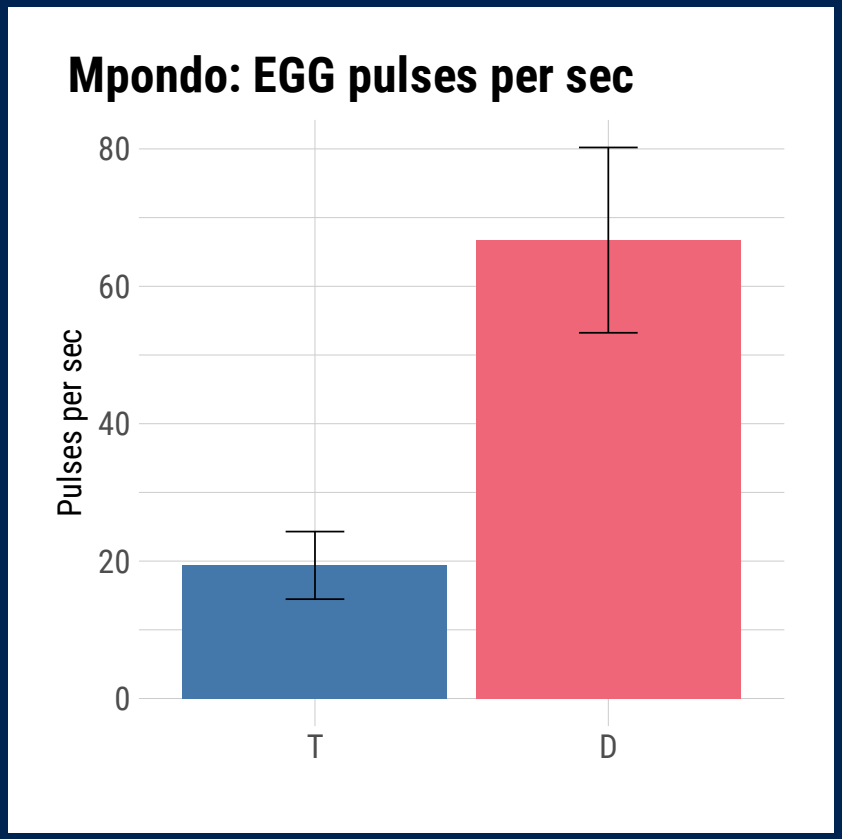


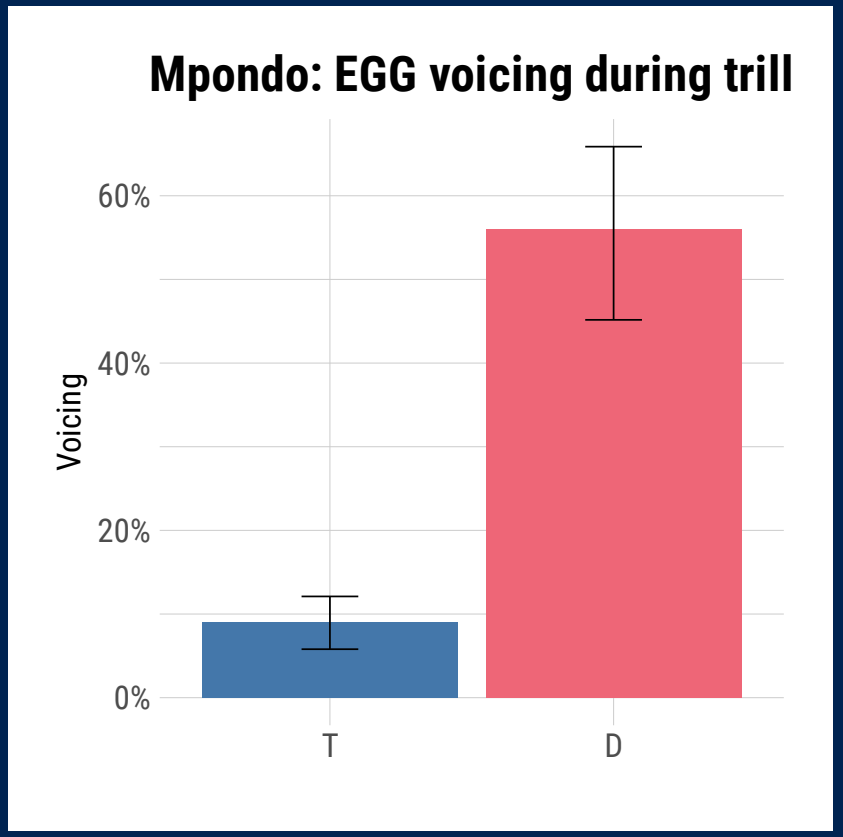


β = 0.297, SE = .390
t(21.828) = 0.761, p = 0.455

β = -0.008, SE = 0.023
t(30) = -0.352, p = 0.727

Trill portion: EGG





β = 47.357, SE = 8.042,
t(86) = 5.889, p < 0.001***

β = 0.468, SE = 0.060,
t(20.000) = 7.864, p < 0.001***

Conclusions

- isiMpondo has an interesting pattern where historical (underlying?) /nt/ and /nd/ are produced with a trilled release
- We have examined acoustic and EGG data for these sounds, and compared them to Xhosa equivalents produced by the same speaker
- Preliminary results: [ntr] and [ndr] seem to be differentiable to speakers, and seem different acoustically (and articulatorily) - but the distinction is manifested differently than is typical for Xhosa nt/nd
- Further study needed to understand where and how the phonetics are distinct; future work to look at following V

Siyabulela

Thank you